FACT SHEET

CSCS – A User Lab for World-Class Research

Run as a User Lab, CSCS (the Swiss National Supercomputing Centre) promotes and encourages top-notch research. A transparent review process by independent experts guarantees that all promising projects receive computer time.

Simulations created on supercomputers yield completely new insights in science. Consequently, CSCS operates cutting-edge computer systems to foster top-level computational research. These computers aid scientists with diverse issues and requirements – from the pure calculation of complex problems to analysis of complex data.

The pool of national high-performance resources is available to its users as a so-called user lab: all researchers in need of the supercomputer infrastructure can apply at CSCS. Disciplines such as physics, materials science, cosmology, earth & environmental science traditionally use high-performance computers like those operated by CSCS. For these researchers, computer simulations have become essential like experiment and theory.

Rising demand

Today, simulations come into play where experiments are no longer possible or our traditional methods no longer suffice. Simulations often provide new insight unavailable from experiment, are complementary when explaining experimental outcome or are a replacement when predicting experimental outcome. Computational approaches are now standard in many disciplines. For example, supercomputers can model new, unknown materials with hitherto unknown properties and functionalities. Additionally, climate models and simple weather forecasts would be impossible without them. In social science, simulations can also help prevent mass panic by simulating people's behaviour. In medicine, computer simulations aid diagnostics and thus help improve treatment methods. Moreover, they facilitate risk assessments for natural hazards such as earthquakes and the tsunamis they trigger.

With the growing number of scientific applications, the number of users and projects at CSCS is therefore constantly on the rise. The rising demand for computational resources is also due to simulations getting more complex over time to increase accuracy and predictive value, to attack larger and more challenging problems.

Allocation schemes and calls

CSCS resources distribute compute time through calls for proposals including different kind of projects. *Production projects* are aimed at the production work for a specific scientific investigation and can be submitted at any time. However, there are only two allocation periods on April 1st and on October 1st and therefore deadlines always apply. Projects are granted access based on scientific merit and technical feasibility and availability of resources.

Development projects are meant for work on codes and algorithms. These projects can be submitted at any time. However, for large development proposals there are only the regular two allocation periods on April 1st and on October 1st similiar to the Production projects.

Preparatory projects are intended for users who are new to CSCS to allow them to port and test their codes before applying for a Production project or existing users who wish to port and test a new code or application or need to generate the required benchmarks, performance analysis and resource justification to be included in the production proposals.

Computer time allocated by independent experts

In the competition for precious computer time, a transparent review process conducted by an independent committee of specialists recommends how the time should be allocated. Every project proposal is evaluated by two scientists who belong to academic establishments from around the world and two technical experts from CSCS. An independent expert committee ultimately ranks the proposals and suggests the allocation of the computer time in a final evaluation based on these assessments. The painstaking procedure is designed to guarantee that all projects be treated equally and all promising projects can be implemented on high-performance computers.

User Lab contributing to the PRACE alliance

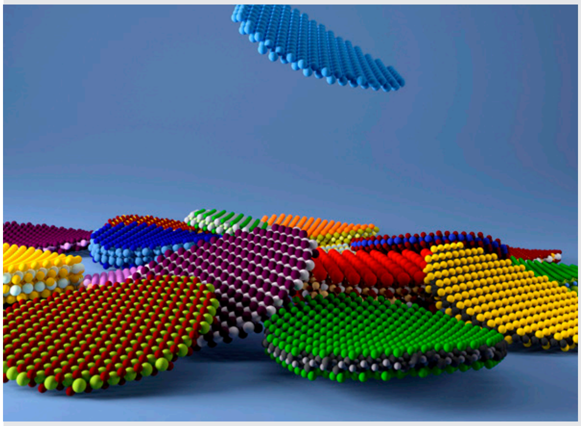
In 2017 CSCS became the fifth hosting member of the European PRACE alliance, which dedicates large shares of supercomputing resources to the best and most ambitious computational projects pursued at European institutions. PRACE, the Partnership for Advanced Computing in Europe, was initiated in 2009, gained significant momentum since it went into its second phase in 2017 and has the objective of enabling high-impact scientific discovery and engineering research and development across disciplines, to enhance European competitiveness for the benefit of society.

As a PRACE hosting member, CSCS offers world class computing and data management resources to the Swiss and European scientific community and contributes with its User Lab with 15 million node hours per year on its flagship GPU-accelerated computer "Piz Daint". The resources are distributed twice a year in the Tier-0 Calls for proposals.

Having CSCS in PRACE is of great advantage to the computational science community in Switzerland. The scientists can get access to different types of extreme-scale computing resources and apply for those best suited to the needs of the project.

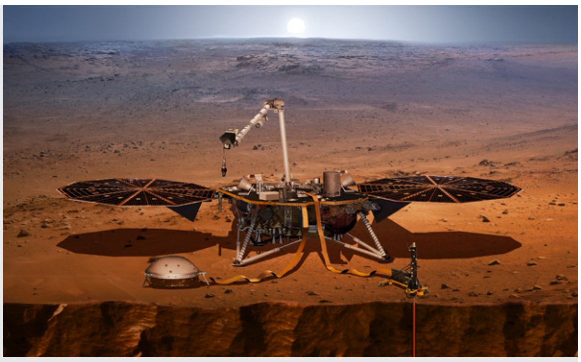
From atoms to the Universe

Materials science is making great strides in the study of optical and electronic properties of existing materials and in the discovery of new ones, as an example, supercomputers are used to identify chemical elements that could drive forward the intensive research in transparent electronics where transparent semiconductors with high level conductivity are in shortage.



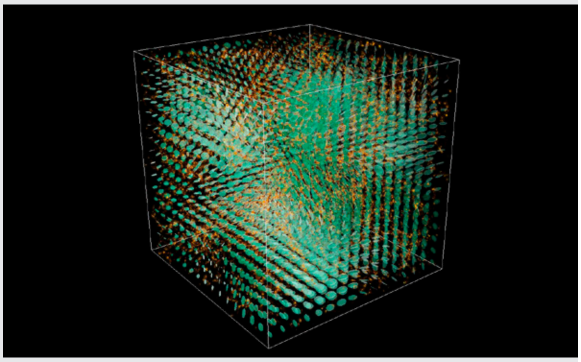
Computational discovery of novel 2D materials. (Image: Giovanni Pizzi, EPFL)

Geoscientists, for instance, with the InSight mission, want to investigate for the first time the internal structure of Mars, there are a number of questions to be answered such as why have Earth and Mars developed so differently although their original structure and chemical composition seem so similar? How large, thick and dense are the core, mantle and crust? What is their structure? Scientists are building a catalog through simulations to model a number of structures to compare with the data to be received from InSight. This is the first time the Red Planet can be investigated so thoroughly and marks the first step in the process of sending a man to Mars.



Artist's rendering of the InSight lander. The sensor assembly of the seismometer (underneath the protective shield) is pictured at the front left. (Image: NASA/JPL-CALTECH)

Cosmologists, for instance, are unable to reproduce the Big Bang in the lab and endeavour to reconstruct the origin and development of the cosmos with the aid of simulations instead. Understanding the development of the universe is of crucial importance as basic principles of physics with far-reaching implications can be confirmed or refuted as a result.



The image shows – greatly exaggerated – space-time being deformed by the spin-2 component of the metric that includes gravitational waves. Mostly, the deformation changes only at a very slow rate and as such cannot be picked up by a detector like LIGO – to do so would require a detector of inconceivable dimensions (the edges of the cube shown measure around 2.5 billion lightyears). (Image: Cosmology and Astroparticle Physics Group University of Geneva)

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